INVENTIONS & INNOVATION

Project Fact Sheet

DEVELOPMENT OF A COMPOSITE-REINFORCED ALUMINUM CONDUCTOR

THE USE OF COMPOSITE MATERIALS IN UTILITY TRANSMISSION AND DISTRIBUTION LINES PROMISES SUBSTANTIAL, LONG-TERM COST AND WEIGHT BENEFITS

Benefits

- Higher current capacity and up to 10% lower electrical resistance than conventional conductors
- Stronger and 50% lighter than conventional steel-core aluminum conductors with up to 2.5 times less sag
- Enables more compact line designs with up to 50% reduction in magnetic fields
- Minimal ice build-up through enhanced heat-transfer characteristics
- Priced competitively with conventional steel-core conductors
- Easily handled by most existing reconductoring equipment
- Well-suited to automated production

Applications

The technology has been designed primarily for domestic utility transmission and distribution systems. This application takes the highest priority as utility deregulation continues to increase the demand for direct-power access. Subsequent applications exist through opportunities in the industrial power, building wire, telecommunications and data transmission, and high-temperature superconductor markets. Similar applications overseas also represent tremendous potential, with growth projected at 10 times that of the United States market.

The millions of people affected by a blackout in the western United States, Canada, and parts of Mexico in July 1996 had no idea the power outage was caused by overloaded transmission lines sagging low enough to touch trees. Millions of New Englanders affected by power outages during the 1997-98 winter probably weren't aware that accumulations of ice and snow on transmission lines had caused the lines to snap. Yet, these two examples illustrate the urgent need to begin upgrading this country's aging electrical-power distribution systems.

A key step in this process lies in improving the weight and conductivity characteristics of utility transmission and distribution lines. Conventional conductors used for overhead transmission and distribution lines are comprised of aluminum strands of wire wrapped around a steel core. The aluminum serves as the electrical conductor, while the steel provides mechanical support. This hybrid design results in an excellent weight-to-conductivity ratio, but it also yields a heavier product, which requires stronger and more costly support structures and limits conductivity. W. Brandt Goldsworthy and Associates, Inc., of Torrance, California, is developing a new composite-reinforced aluminum conductor to replace aging steel-core lines. The new composite conductor is lighter, stronger, and carries a higher current capacity than traditional power lines.

COMPOSITE-REINFORCED ALUMINUM CONDUCTOR

The new composite-reinforced aluminum conductor is stronger, lighter, and has a higher current capacity than conventional utility transmission lines.

Project Description

Goal: The goal of this project is to develop an automated, high-throughput manufacturing method capable of producing the composite-reinforced aluminum conductor reliably and at a cost competitive with conventional conductors. This new composite conductor significantly improves performance by replacing the steel core with composite glass-fiber materials. The fiber is not of the same high purity as optical fiber, but a higher-strength, lower-cost version optimized for mechanical properties. Present designs employ the composite fibers as either an inner core, directly replacing the traditional steel core, or as an outer shell, depending on the application. Aluminum is still used to carry the current. The tensile strength of glass fiber is 250% that of steel, which means less composite materials are needed to provide the same strength as the steel core, thereby freeing up space for more current-carrying aluminum. The resulting composite-reinforced aluminum conductor should exhibit superior weight, strength, and current-carrying capacity over conventional steel-core designs. W. Brandt Goldsworthy and Associates, Inc., is developing this new technology with the help of a grant funded by the Inventions and Innovation Program through the Department of Energy's Office of Industrial Technologies.

Progress and Milestones

W. Brandt Goldsworthy and Associates, Inc., has also attracted investment interest in the form of cofunding from California's Technology Investment Partnership, as well as commitments of support and cooperation from the utility and conductor industries.

The company has created conceptual designs and performed small-scale prototype experiments to substantiate some early performance parameters. Now the company is working to confirm whether the technology's design can be adapted to the company's proprietary manufacturing process.

Economics and Commercial Potential

Based on promising early-stage research, W. Brandt Goldsworthy and Associates, Inc., should be able to apply its own previously developed proprietary manufacturing process to the task of producing the needed glass-fiber composite material. This continuous, mass-production process will keep the cost of the finished product low enough to compete with conventional conductors.

The company's initial target is the $640-million-per-year transmission-line market, involving an estimated 233,000 miles of new and existing transmission line annually. If early market-entry signs warrant, the real target becomes the domestic distribution-line system. Though margins are lower, the $2-billion-a-year distribution market contains 10 times more line than the transmission segment.

The composite-reinforced aluminum conductor is ideally suited to the transmission and distribution markets for several reasons. Because existing towers and poles could be used without modification, and no additional right-of-way land would be needed, line-permitting time and cost would be greatly reduced. Also, because glass-fiber composites are so much stronger than steel, line tension with the subject technology could be increased, thereby reducing sag and swing. The resultant improvement n service reliability, if great enough, could actually be rewarded under new performance-based rate making regulations.

The Inventions and Innovation Program works with inventors of energy-related technologies to establish technical performance and to conduct early development. Ideas that have significant energy-savings impact and market potential are chosen for financial assistance through a competitive solicitation process. Technical guidance and commercialization support are also extended to successful applicants.

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